Space Weather Technical Forecast

Issued on Sunday, 05 May 2024 at 12:13 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares expected with a chance of isolated X-flares through the period. G1/G2 (Kp 5-6) conditions are likely on days 1 and 2 (5-6 May) given likely CME arrival, with a chance of isolated G3 (Kp7) intervals. Lowering chance of further geomagnetic activity days 3 and 4 (7-8 May).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at High levels. A current peak flare of X1.3 recorded at 05/0601 UTC from AR3663, with another X-flare ongoing and further flares of M9.0 at 04/2348 UTC, M8.4 at 05/0127 UTC and several lower M-Class flares have also been observed during the period from this region. The recent M7.4 flare from a combined source of AR3663 and AR3664. There are currently nine sunspot regions on the visible disc, with seven numbered, two unnumbered. The most active remains AR3663, located in the northwest, with a large and complex intermediate region and a broad delta configuration. This region continues to show evolution in the magnetic structure. AR3664 is the second largest spot on the disc and located in the southeast, also with a delta configuration in its southern intermediate spot, where the bulk of the recent areal growth is occurring. AR3666 has shown some decay in recent imagery, remaining largely quiet at this time. The remaining sunspots on the disc are generally smaller, stable or in slight decay, and magnetically simple.

A largely northward directed CME was observed following the M8.3 flare early on the 5 May, analysis was undertaken on limited available imagery with modelling output awaited. No other obvious Earth directed CMEs have been observed, however updated LASCO/SOHO coronagraph imagery is currently unavailable, and STEREO-A imagery is limited, therefore confidence is lower than normal.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 was at background levels, 320-370km/s. Density was mainly below average to average, but with a recent Moderate peak of 19 ppcc at 04/2214 UTC. The Interplanetary Magnetic Field, Bt, was at weak levels throughout. The north-south component, Bz, varied weakly. Phi angle was mostly negative (towards the Sun). but switched to a couple of periods of positive (away from the Sun) in the second half of the period. Resultant Geomagnetic activity was predominantly Quiet, with an isolated Unsettled interval prior to midnight UTC (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at normal background levels. High energy electron flux (greater than 2MeV) observed at GOES16 remained at background levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 05/0001UTC was 1.31e6 integrated pfu on a largely steady trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast to continue with further M-flares expected and a chance of isolated X-flares, principally from AR3663 and AR3664.

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Solar Wind / Geomagnetic Activity: Three Earth-directed CMEs currently feature in the forecast period. The 01 May filament CME may yet provide a glancing impact day 1 (05 May), the second more significant CME associated with the 03 May X-flare is expected into the second half of the day 1 (05 May), with the third the 04 May M9-flare CME possibly glancing late day 2/early day 3 (6 to 7 May).

Some HSS influence from CH35/+ and CH33/+ is also expected into days 1 and 2 (05-06 May) and could see speeds peak at elevated levels between days 2 and 3 (06 and 07 May) before slowly declining although CME influence may mask this signal.

Combining effects from the various CMEs and HSS influences through the period results in a lower than average Geomagnetic forecast confidence.

Geomagnetic activity although initially Quiet, is expected to increase on day 1 (05 May), becoming Active to G1/Minor Storm with a chance of G2/Moderate to G3/Strong Storm conditions. Activity should generally subside through days 2-4 (06 to 08 May) to mostly Quiet conditions by the end of the period. Any glancing pass from 4 May CME could give a slight chance of reaching G1 levels late day 2/early day 3 (06 and 07 May).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels through the period. There is a slight chance for an S1/Minor Storm or greater event throughout however, primarily from AR3663.

High energy electron flux is forecast to be at background to moderate levels throughout, with associated fluence expected to remain well below the Active (1e8 integrated pfu) threshold.

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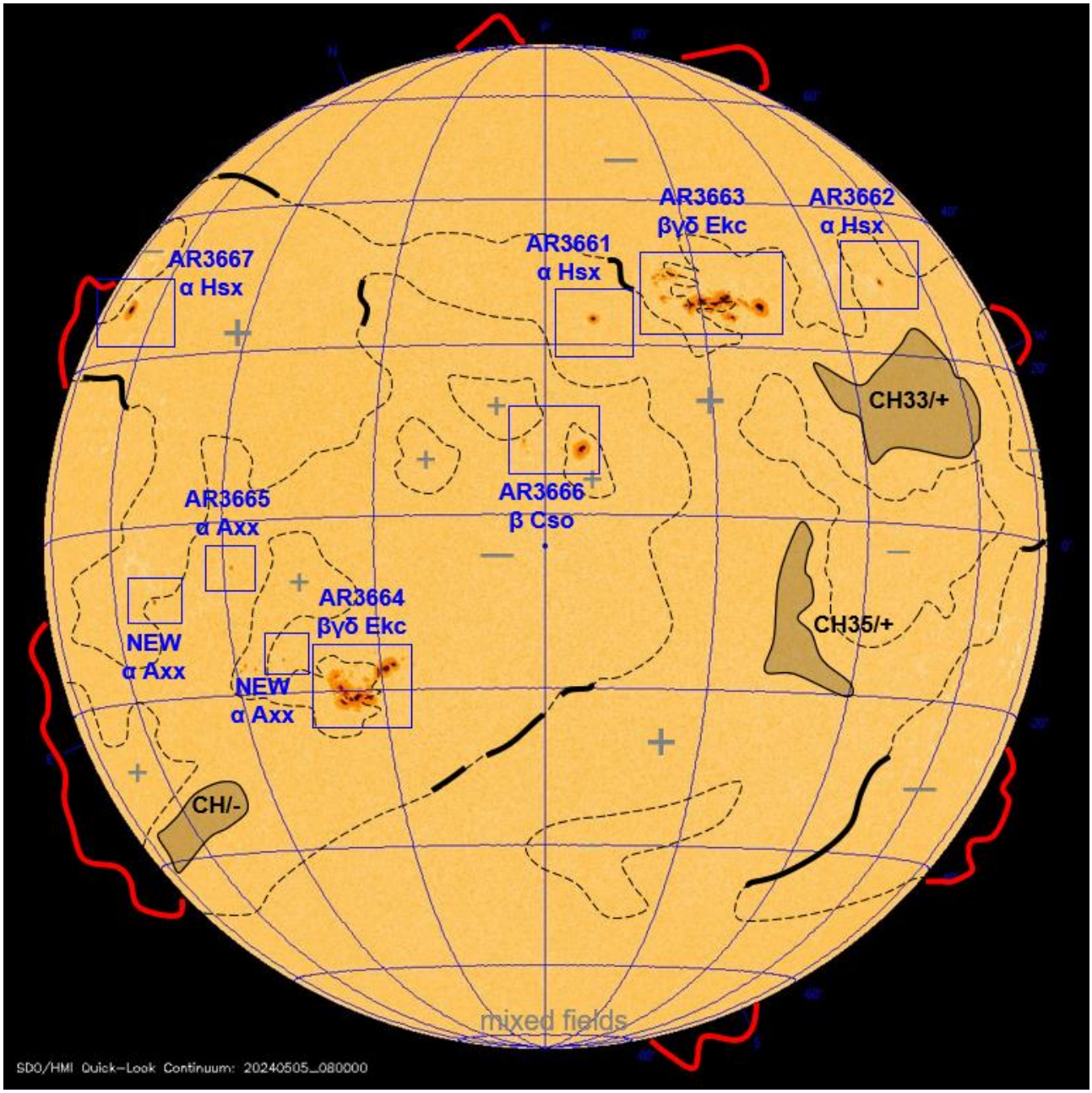
Figure 1. Solar Analysis Valid 05/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:
Three Earth-directed CMEs currently feature in the forecast period. A CME that left the Sun around 01/0600 UTC from the southwest disc, resulting from a large filament eruption, may yet provide a glancing impact day 1 (05 May). A potentially more significant Earth directed CME associated with the X1.6 flare 03/0222 UTC, is expected to interact with Earth towards the second half of the day 1 (05 May). Both features carry greater than average uncertainty with respect to timings and magnitude of effects, given limitations in imagery available for analysis. A largely northward directed CME followed the M9 flare on the 4th May, analysis shows a possible glancing interaction late day 2/early day 3 (6 to 7 May) , although once again limited imagery reduces confidence.

HSS enhancement from coronal holes CH33/+ and CH35/+ may also increase solar wind speeds later on day 1 into day 2 (05-06 May) as these regions look to become geo-effective. The coronal holes while broadly persistent are noticeably larger than the previous rotation and could see speeds peak at elevated levels between days 2 and 3 (06 and 07 May) before slowly declining, although CME influence may largely dominate the signal.

The combination of possible impacts from the various CMEs and HSS influences through the period, as well as ongoing gaps in imagery, results in a lower than average Geomagnetic forecast confidence throughout.

Geomagnetic activity although initially Quiet, is expected to increase on day 1 (05 May), becoming Active to G1/Minor Storm with a chance of G2/Moderate to G3/Strong Storm conditions. Activity should generally subside through days 2-4 (06 to 08 May) to mostly Quiet conditions by the end of the period. Any glancing pass from 4 May CME could give a slight chance of reaching G1 levels late day 2/early day 3 (06 and 07 May).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	80	70	20	5
Strong	G3	No	30	20	1	1
Severe	G4	No	10	5	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1259	Partial	Filament	SW	585 km/s	05/1200 UTC	Glance possible
03/0646	Partial	AR3663	NE	900 km/s	05/1800 UTC	Reduced confidence
04/1125	Partial	AR3663	NE	650 km/s	07/1200 UTC	Reduced confidence

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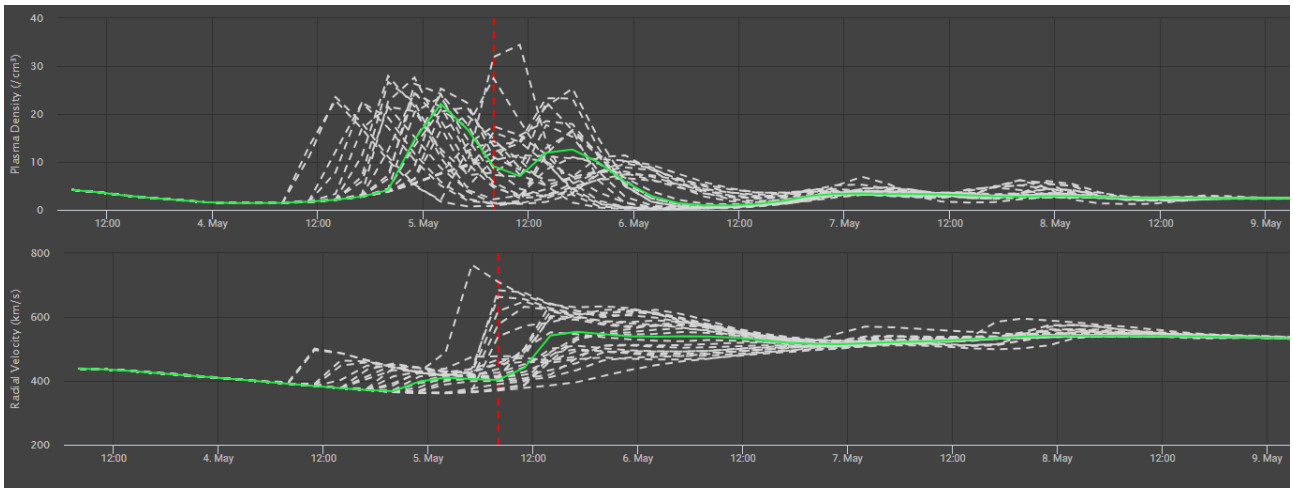
Figure 2: Latest MOSWOC ENLIL ensemble output showing main features discussed above.



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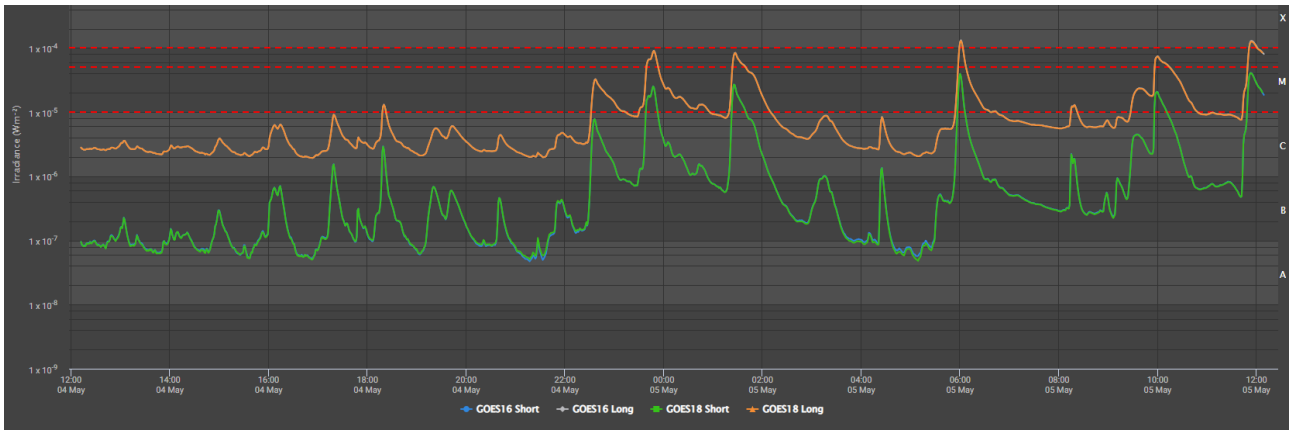
Radio Blackouts - X-Ray Flares:
High solar activity There are currently nine sunspot regions on the visible disc, seven numbered, and two unnumbered. The most active region remains AR3663, located in the northwest, which has given the bulk of recent flare activity including the recent X1.3 flare. This region continue to display a large and complex intermediate spot with a broad delta configuration. The overall size of this region appears fairly steady but with signs of increased horizontal sheer and a slight increase in total flux values in recent hours, likely maintaining, or perhaps increasing slightly, the flare risk from this region. AR3664 is the second largest spot on the disc and located in the southeast, also with a delta configuration in its southern intermediate spot, where the bulk of the recent areal growth is occurring. AR3666 has shown some slowing of the evolution in recent imagery, remaining largely quiet over the past 24hrs although a contribution to the most recent M-flare shows that the risk continues for significant flare activity. The remaining sunspots on the disc are generally smaller, stable or in slight decay, and significantly more magnetically simple.

Both AR3663 and AR3664 remain on the visible disk throughout the period, and far-sided helioseismographs indicate a number of returning regions over the northeast horizon in the coming days that may supplement the present risk of significant flares should they persist.

Moderate to High solar activity is therefore forecast to continue pending further developments, with occasional M-flares expected and a chance of isolated X-flares throughout, principally from AR3663 and perhaps to a lesser extent AR3664.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	90	90	90
Very Active	R3 to R5 X Class	Yes	25	25	25	25

Figure 3: Latest 24hr GOES16/18 X-ray trace, showing increased recent activity chiefly from AR3663, including current ongoing flare enhancement at time of issue.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. However, there is a slight chance of an S1/Minor Storm or greater event occurring throughout, primarily from AR3663 as it transits westward although recent significant flares from this region have so far failed to trigger any significant proton response.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux is at normal background levels. Likely CME and coronal hole influences through the period are expected to limit electron flux at background to moderate levels on all days.

Overall, the 24 hour integrated electron fluence is forecast to remain well below the Active (1e8 integrated pfu) threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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